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(54) Abstract Title
Digital still camera with strobe mode selection

(57) A strobe or flash (74) and a strobe charge/discharge circuit are mounted in the housing (14) of a digital still camera (10). A plurality of manually actuable controls (62, 64, 66a, 66b, 68, 70a, 70b) are mounted in the housing (14) so that they can be manipulated by the fingers of a user. A control circuit permits the user to select a current strobe mode and a default strobe mode from a plurality of strobe modes by manually actuating the controls (62, 64, 66a, 66b, 68, 70a, 70b). The control circuit causes the strobe (74) to be fired in accordance with the current strobe mode during a current picture taking session and the default strobe mode after the current picture taking session is terminated and the camera (10) is subsequently powered ON. The control circuit is connected to the strobe charge/discharge circuit for firing the strobe under predetermined conditions when a picture is taken in accordance with one of the plurality of strobe modes. The control circuit is mounted in the housing (14) and connected to the processing circuit for generating a plurality of image files from sets of pixels and storing the image files in a memory. The strobe modes may include strobe ON, strobe OFF, automatic strobe, red-eye auto and red-eye ON.

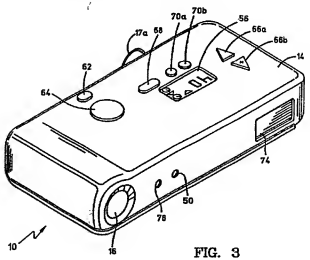

FIG. 3

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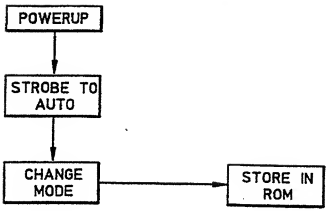

FIG. 1
PRIOR ART

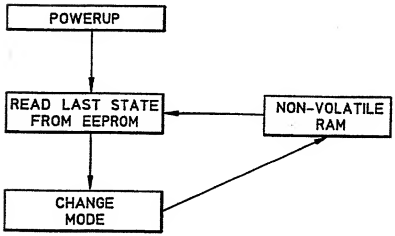

FIG. 2
PRIOR ART

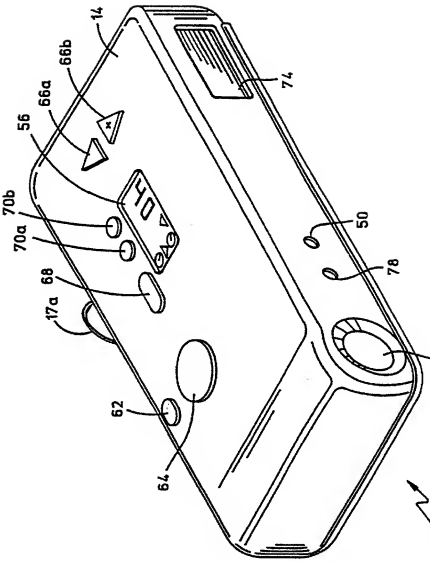

FIG. 3

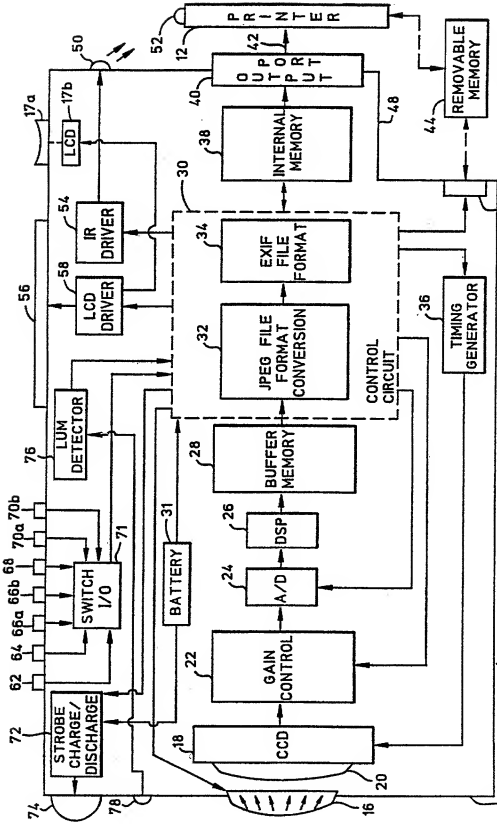
PRINTER
OUTPUT
INTERNAL MEMORY
REMOVABLE MEMORY
LCD
IR DRIVER
LCD DRIVER
EXIF FILE FORMAT
JPEG FILE FORMAT CONVERSION
CONTROL CIRCUIT
TIMING GENERATOR
LUM DETECTOR
BUFFER MEMORY
DSP
A/D
GAIN CONTROL
CCD
SWITCH I/O
BATTERY
STROBE CHARGE/ DISCHARGE
50
52
12
42
40
38
48
44
17a
17b
54
58
56
34
32
30
36
46
76
28
26
24
22
18
20
16
14
10
70b
70a
68
66b
66a
64
62
72
74
78
31
71

FIG. 4

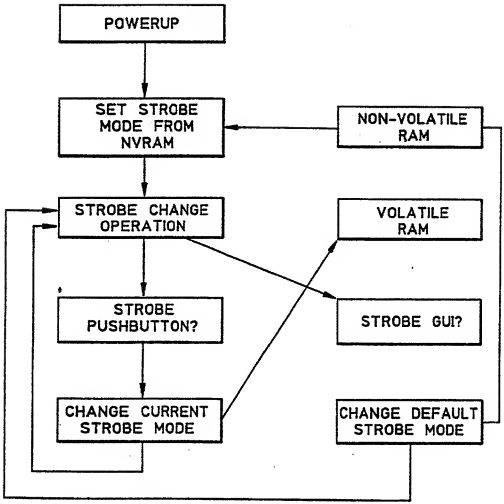
POWERUP
SET STROBE MODE FROM NVRAM
NON-VOLATILE RAM
STROBE CHANGE OPERATION
VOLATILE RAM
STROBE PUSHBUTTON?
STROBE GUI?
CHANGE CURRENT STROBE MODE
CHANGE DEFAULT STROBE MODE

FIG. 5

DIGITAL STILL CAMERA WITH STROBE CONTROL

The present invention relates to electronic still photography, and more particularly, to a digital still camera (DSC) with an improved customizable strobe default that ensures, for example, that after powering ON the camera, novice users won't take under exposed pictures and expert users will avoid having to continually change the strobe mode.

DSCs are rapidly gaining in popularity with consumers as an alternative to conventional still cameras that use silver halide film. The number of pixels in the color electronic images has increased to the point where picture detail and clarity are acceptable to consumers. The digital images can be selected and enhanced before printing with home photo album software, eliminating the cost and expense of purchasing and developing traditional camera film. Advancements in ink jet and laser printer technology, inks and paper allow color prints to be generated from digital images that rival the quality of silver halide color prints. Digital images taken with a DSC can be cut and pasted into various word processing and other publishing applications used on personal computers (PCs). In addition, the digital images can be used in web pages and can be transmitted over the Internet. From an environmental standpoint, electronic still photography is attractive because it reduces the need for silver halide film manufacture as well as the handling and disposal of chemical developer solutions.

DSCs use flashes just like ordinary silver-halide film cameras to compensate for low ambient light conditions. Otherwise pictures end up "under exposed" which means that the

digital images have insufficient brightness, inadequate contrast and/or poor color balance. The strobe in a conventional DSC is typically a gas discharge tube that is "fired" by a charging circuit in the camera to illuminate objects and scenes of interest. In the digital camera art, the terms "flash" and "strobe" are used interchangeably. Conventional DSCs typically allow the user to select a strobe mode, e.g. a "strobe ON" mode, a "strobe OFF" mode, and an "AUTOMATIC" strobe mode, by depressing a pushbutton on top of the camera housing that results in the DSC switching between different modes. Most DSCs also have "RED EYE AUTO" and "RED EYE ON" strobe modes. Other conventional DSCs have required the user to go through the graphical user interface (GUI) on an LCD display to select the desired strobe mode.

In the strobe ON mode the strobe is energized and flashes for each picture taken, regardless of the amount of ambient light. In the strobe OFF mode the strobe is not energized and does not flash for each picture taken, regardless of the amount of ambient light. In the AUTOMATIC strobe mode the ambient luminescence is detected by an internal control of the DSC each time a picture is taken and the strobe is energized if needed in accordance with pre-programmed luminescence levels.

In the RED EYE AUTO strobe mode if a scene needs more light to prevent the annoying feature of human red eyes in the resulting pictures the flash is energized in a repetitive sequence. In the RED EYE ON strobe mode the flash is energized in the repetitive sequence regardless of the level of ambient light detected.

When first powered ON, conventional DSCs have automatically selected a particular strobe mode. Referring to Fig. 1, when a first type of conventional DSC is powered ON, i.e. goes through a powerup sequence the internal control always resorts to a default mode which is usually the AUTOMATIC strobe mode. The user can change the strobe mode and this selection will be stored in a random access memory (RAM). The camera will stay in the selected strobe mode during the current picture taking session, but that strobe mode selection will be lost when the camera is powered OFF. When the camera is once again powered ON, it will resort to the default strobe mode, which is usually the AUTOMATIC strobe mode.

Referring to Fig. 2, when a second type of conventional DSC goes through its powerup sequence the internal control determines from a non-volatile random access memory (NVRAM) the last strobe mode or state that was selected by the user and goes into that strobe mode. The user can then change the strobe mode and it will be stored in the non-volatile RAM. The camera will stay in the selected strobe mode, whether it is powered ON and OFF, until the user changes the strobe mode. Thus in the second type of conventional DSC, the camera remembers the last strobe mode selected and maintains that mode during the current picture taking session, and always reverts back to that strobe mode when powered OFF and then powered ON again, until the user manually selects a new strobe mode.

The first type of DSC (Fig. 1) is good for protecting users from forgetting that the camera has been set to a certain strobe mode. For example, the user may select the strobe OFF mode with the second type of DSC (Fig. 2) when taking pictures under high light conditions. The DSC may then be turned OFF. The user may later power ON the second type of DSC and take a picture in low light conditions without remembering to change out of the strobe OFF

mode. The user may then store the second type of DSC away for a period of time, and will later be disappointed with an "under exposed" picture when it is too late to retake the shot. If the first type of DSC is used, the user would always get a properly exposed picture in low light conditions since the DSC will usually resort to the AUTOMATIC strobe mode when powered ON.

The second type of DSC (Fig. 2) is better for more advanced users that prefer one strobe mode over another. For example a photographer that has set up the second type of DSC in a studio and wants special artificial lighting to illuminate the scene will select the strobe OFF mode. This type of sophisticated user will not want to go through all the steps of selecting the strobe OFF mode each time he or she powers ON the DSC which would be necessary with the first type of DSC. The more advanced user prefers the second type of DSC that "remembers" the last mode that has been selected each time the DSC is powered ON.

It would therefore be desirable to overcome the shortcomings of the strobe mode selection and operation of conventional DSCs.

It is therefore the primary object of the present invention to provide a digital still camera (DSC) with a customizable strobe default.

It is another object of the present invention to provide a method of operating a digital still camera that allows the user to customize the strobe default of the camera.

In accordance with the present invention a digital still camera with a customizable strobe default includes a housing and a lens mounted in the housing for transmitting light from objects and scenes of interest. An image sensor is mounted in the housing for receiving the light transmitted through the lens and generating output signals representative of an image of an object or a scene of interest. A processing circuit is mounted in the housing and connected to the image sensor for processing the output signals from the image sensor as a plurality of pictures are taken in succession to generate a plurality of sets of pixels representative of a plurality of images of objects and scenes of interest. A strobe and a strobe charge/discharge circuit are mounted in the housing. A plurality of manually actuable controls mounted are in the housing so that they can be manipulated by the fingers of a user. A control circuit is mounted in the housing and connected to the processing circuit for generating a plurality of image files from the sets of pixels and storing the image files in a memory. The control circuit is connected to the strobe charge/discharge circuit for firing the strobe under predetermined conditions when a picture is taken in accordance with one of a plurality of strobe modes. The control circuit permits the user to select a current strobe mode and a default strobe mode from the plurality of strobe modes by manually actuating the controls. The control circuit causes the strobe to be fired in accordance with the current strobe mode during a current picture taking session and the default strobe mode after the current picture taking session is terminated and the camera is subsequently powered ON.

The present invention also provides a method of controlling the strobe operation of a digital still camera. The method involves the steps of, during a powerup sequence of the camera, setting a strobe operating mode of the camera to a previously programmed strobe default mode and discharging the strobe in accordance with the default mode during a current

picture taking session. The method further involves the step of permitting the strobe operating mode of the camera to be changed to a current strobe mode during the current picture taking session and thereafter discharging the strobe in accordance with the current strobe mode only during the current picture taking session. In addition, the method involves the step of permitting the strobe operating mode of the camera to be changed to a default strobe mode and thereafter discharging the strobe in accordance with the default strobe mode during the current picture taking session and after the powerup sequence of the camera until the strobe operating mode is either changed to a different current strobe mode or a different default strobe mode.

Fig. 1 is a flow diagram illustrating the operation of a first conventional type of DSC which goes to a default strobe mode, usually the AUTOMATIC strobe mode, when powered ON and thereafter allows manual strobe mode selection.

Fig. 2 is a flow diagram illustrating the operation of a second conventional type of DSC which remembers the last strobe mode setting when powered ON and thereafter allows manual strobe mode selection.

Fig. 3 is a perspective view of a digital still camera constructed in accordance with a preferred embodiment of the present invention.

Fig. 4 is a block diagram of the digital still camera of Fig. 3 illustrating its electronic circuitry.

Fig. 5 is a flow diagram illustrating the operation of the customizable strobe default of the digital still camera of Figs. 3 and 4.

Referring to Figs. 3 and 4, a digital still camera 10 constructed in accordance with the present invention is shown in perspective, and block diagram form, respectively. The camera 10 has a customizable strobe default that ensures, for example, that after powering ON the camera, a novice user won't take under exposed pictures and an expert user will avoid having to continually change the strobe mode. This design protects the novice user from leaving the camera in a state other than AUTO and also allows the expert user to fix a strobe mode setting and avoid re-setting the strobe mode each time the camera is powered ON.

The camera 10 is capable of transferring digital images to a printer 12 (Fig. 4) via cable connection, removable memory or wireless transmission, as explained hereafter in greater detail. Referring to Fig. 3, the camera 10 includes a compact, generally rectangular outer plastic camera body or housing 14 that encloses and supports the operative components of the camera in conventional fashion. A lens 16 is mounted in a forward side wall of the housing 14 for transmitting therethrough light from objects and scenes of interest. An eyepiece 17a (Figs. 3 and 4) on the rear side wall of the housing 14 forms part of a view finder that allows the user to view objects and/or scenes of interest through the lens 16 or to view electronically recorded images displayed on a small, internal color liquid crystal display (LCD) 17b (Fig. 4). This is accomplished using a pair of pivoting mirrors (not illustrated) inside of the housing 14.

An image sensor 18 (Fig. 4), preferably in the form of an array of charge coupled devices (CCDs), is mounted in the housing 14 behind the lens 16 for receiving the light transmitted through the lens 16. The image sensor 18 generates analog output signals representative of an image of an object or scene of interest. One of the mirrors inside the housing 14 may be pivoted to selectively send light received through the lens 16 to the eyepiece 17a or the image sensor 18. The other mirror may be pivoted to allow the user to view objects and scenes through the lens 16 or to view electronic images on the internal LCD 17b as indicated by the dashed line in Fig. 4.

Referring to Fig. 4, an array 20 of color filters overlies the forward side of the image sensor 18. The analog signals from the image sensor 18 are serially fed to a gain control circuit 22 the output of which is fed to an analog-to-digital (A/D) converter 24. The digital output of the A/D converter 24 is fed to a digital signal processing (DSP) circuit 26, the output of which is fed through a buffer memory 28 to a control circuit 30. The control circuit 30 receives power from a battery 31 and includes a micro-controller or microprocessor as well as a JPEG file format conversion component 32 and an EXIF file format component 34.

Referring still to Fig. 4, light from images and scenes of interest enters the camera 10 through the lens 16 as indicated diagrammatically by the arrows and passes through the color filters 20 before being focused on the active face of the image sensor 18. As is well known in the art, the color filters associated with the various detectors in the CCD array of the image sensor 18 cause the detectors to be sensitive to light of one particular color. By way of example only, the CCD detectors may be configured in a repeating pattern of two by two groups in which the top right detector is sensitive to red light, the top left detector is sensitive to blue

light, the bottom right detector is sensitive to green light and the bottom left detector is sensitive to blue light. Each detector of the CCD array accumulates a charge that represents the amount of light in one CCD pixel. A timing generator 36 is coupled between the control circuit 30 and the image sensor 18. The timing generator 36 controls the reading of the array of CCD detectors that make up the image sensor 18 in conventional fashion. The charge accumulated by each CCD detector is serially applied to the input of the gain control circuit 22.

The timing generator 36 (Fig. 4) is capable of periodically flushing the CCD array of the image sensor 18. The gain control circuit 22 implements a conventional correlated double sampling process. This double sampling process accounts for overshoot and undershoot in the outputs of the CCD detectors as the output voltages from each of the detectors in the CCD array are read. The A/D converter 24 converts to digital values the analog voltages read from the CCD detectors after they have been adjusted by the gain control circuit 22.

The DSP 26 (Fig. 4) processes the digital signals from the A/D converter 24 so as to provide a demosaic function, and also performs automatic white balance detection and correction, as well as image sharpening functions in accordance with well known techniques. By way of example, the DSP 26 may be provided in the form of Part No. HD49811TFA commercially available from Hitachi. The output of the DSP 26 is a set of image pixels, each of which represents the color of a particular portion of the image that was captured by the CCD array of the image sensor 18. The entire set of image pixels associated with a complete flushing of the CCD array represents a single image of an object or scene of interest whose "picture" has been "taken" with the camera 10.

The micro-controller of the control circuit 30 (Fig. 4) may execute firmware to provide the JPEG file format conversion component 32. Alternatively, the JPEG file format conversion component may be a dedicated hardware circuit or a combination of hardware and software. The JPEG file formal conversion device compresses the information output received from the DSP 26 through the buffer memory 28 in accordance with a well known JPEG data compression standard. The image information which is in JPEG format is fed to the EXIF file format component 34 which embeds the JPEG format image information within a file that conforms to the DIGITAL STILL CAMERA FILE FORMAT STANDARD (Version 1.0, July 13, 1995) commonly known as EXIF. The micro-controller of the control circuit 30 may execute firmware to provide the EXIF file format component 34. Alternatively, the EXIF file format component 34 may be a dedicated hardware circuit or a combination of hardware and software.

Referring again to Fig. 4, the portions of the camera 10 represented by the elements 22, 24, 26, 28 and 36 process the output signals from the image sensor as pictures are taken in succession to generate sets of pixels representative of a plurality of images of objects or scenes of interest. The control circuit 30 converts these sets of pixels into a plurality of image files representing images of the objects and scenes of interest. The image files are in the EXIF file format and represent a sequence of pictures taken with the camera 10. These image files may be stored in an internal memory 38 and can be conveyed via an output port 40 mounted in the housing 14 of the camera to a cable 42 connected to the printer 12. By way of example, the memory 38 may comprise a non-volatile random access memory ("NVRAM") portion and a volatile RAM portion. Alternatively, it will be understood by those skilled in the art that the cable 42 could be connected to a PC (not illustrated) so that the image files in EXIF format

could be further processed in the PC, displayed on its monitor, or downloaded to a printer connected to the PC. Alternatively, as described herein later on in detail, the user of the camera 10 may choose to transmit selected image files to the printer 12 via a removable memory 44.

The memory 44 (Fig. 4) is preferably a flash memory card that plugs into a female connector 46 in a receptacle or slot 48 formed in an outer surface of the camera housing 14. A floppy diskette or some other form of removable storage media could be used instead of a flash memory card. As another alternative, the user of the camera 10 may choose to transmit selected image files to the printer 12 by utilizing a wireless data link including an infrared (IR) transmitting device 50 (Figs. 3 and 4) mounted in an outer surface of the camera housing 14. In such a case, the printer 12 receives the IR radiation in which image data has been encoded via an IR receiver 52 (Fig. 4) mounted on the exterior of the printer housing. The printer 12 has conventional circuitry connected to the IR receiver 52 for decoding the image data from the received IR signals. The IR transmitting device 50 is connected to an IR driver circuit 54 which is controlled by control circuit 30 to transmit the desired image data as hereafter described.

A display 56 (Fig. 3) is mounted in the top side of the camera housing 14 for viewing by the camera user. The display 56 is preferably an LCD that can display alphanumeric and graphical information. The display 56 is driven in conventional fashion by the LCD driver circuit 58 (Fig. 4) controlled by the control circuit 30. The LCD driver circuit 58 also drives the internal LCD 17b on which recorded images are displayed upon command for viewing through the eyepiece 17a of the camera viewfinder. The display 56 can display a series of menus providing a plurality of command options that can be selected by the user as part of a graphical

user interface (GUI) generated by the control circuit 30 using a control program stored in the internal memory 38.

A plurality of manually actuable controls 62, 64, 66a, 66b, 68, 70a and 70b (Figs. 3 and 4) are mounted in the outer surface of the camera housing 14 so that they can be readily manipulated by the fingers of the user while viewing the display 56. By way of example, the manually actuable controls 62, 64, 66a, 66b, 68, 70a and 70b may be of the pushbutton type. The pushbutton 62 may be depressed to power the DSC 10 ON and OFF and the pushbutton 64 may be depressed to "take a picture". The manually actuable controls 66a and 66b may be depressed to scroll up and down through command options displayed on the display 56. The pushbutton 68 depressed to select the command option currently highlighted or marked with a cursor. The other push buttons 70a and 70b may be depressed to control other functions such as current strobe mode selection and date/time entry, respectively. The current strobe mode can be selected from a "strobe ON", a "strobe OFF", an "AUTOMATIC" strobe mode, a "RED EYE AUTO" strobe mode and a "RED EYE ON" strobe modes. Each time the pushbutton 70a is depressed an indication of the current strobe mode can be displayed by the LCD 56. When the desired current strobe mode is displayed, it can be selected and activated in the camera 10, by, for example, depressing the pushbutton 68.

As described hereafter in greater detail, the user can depress the strobe pushbutton 70a (Figs. 3 and 4) with his or her index finger to set a current strobe mode for the current picture taking session once the DSC 10 has been powered ON. The manually actuable controls on the camera housing 14 could include a dial rotatable (not shown) to select one of several different operating modes of operation by placing a pointer on the dial next to the desired mode. These

different operating modes may include a picture taking mode, a review/preview mode, a date/time entry mode, and so forth. The dial would be used for mode selection in lieu of, or as an alternative to, mode selection through the GUI via pushbuttons 66a and 66b. The manually actuable controls 62, 64, 66a, 66b, 68, 70a and 70b interface with the control circuit 30 through a switch input/output (I/O) buffering device 71 (Fig. 4) in conventional fashion.

A conventional strobe charge/discharge circuit 72 (Fig. 4) is connected between the control circuit 30 and a strobe or flash 74 (Figs. 3 and 4) mounted in a front side of the camera housing 14. The strobe 74 may comprise a gas discharge tube which will flash a bright light on the object or scene of interest when "fired" or energized by the strobe charge/discharge circuit 72 (Fig. 4) in response to a command from the control circuit 30. The strobe 74 is fired in accordance with the current strobe mode during a current picture taking session. The strobe charge/discharge circuit 72 receives power from the battery 31. When the DSC 10 is set to ane AUTOMATIC strobe mode the ambient luminescence is detected by the control circuit 30 of the DSC 10 each time a picture is taken and the strobe 74 is energized if needed in accordance with pre-programmed luminescence levels. To facilitate this operation, the DSC 10 includes a luminescence detector circuit 76 (Fig. 4) that receives the analog output signal of a suitable luminescence detector 78 (Figs. 3 and 4) mounted in the front side of the camera housing 14.

The control circuit 30 also causes a series of menus to be displayed on the display 56 providing command options that can be selected upon manual actuation of one of the pushbutton controls. Upon manual actuation of certain ones of the pushbutton controls in the appropriate sequence the control circuit 30 causes individual stored images to be displayed on the small internal LCD 17b so that they can be viewed via the eyepiece 17a (Figs. 3 and 4) of

the viewfinder. The LCD 56 on top of the camera housing 14 is used solely for displaying alphanumeric data and graphic symbols as part of the GUI. The control circuit 30 causes a markup file to be generated in response to the user's selection of a first predetermined sequence of command options via manipulation of the pushbutton controls. The markup file represents the designation of image files for further processing. The markup file can include information not only about which pictures are being selected, but how many copies are desired. In addition, the markup file can also include information about image enhancements to be performed on the selected images, such as rotation, cropping, brightening, etc.

Once the markup file has been generated, the user can, by following the appropriate menus on the display 56 and actuating the appropriate pushbutton controls, send the designated image files to the printer 12 via the cable 42, removable memory 44 or IR transmitter 50. Regardless of the mode of data transfer, the printer 12 receives all of the selected image files designated in the markup file and all of the information about quantity and enhancements. The markup file need only be created once by the user, and the information designated therein can then be used in any of the three modes of data transmission, i.e. via cable 42, removable memory 44 or IR transmitter 50.

As part of the GUI the control circuit 30 also causes a menu of various strobe modes to be displayed on the LCD 56, including a "strobe ON" mode, a "strobe OFF" mode, an "AUTOMATIC" strobe mode, a "RED EYE AUTO" strobe mode and a "RED EYE ON" strobe mode. Any single one of these modes can be selected as the default strobe mode using the GUI, e.g. by scrolling with pushbuttons 66a and 66b and depressing pushbutton 68 when the desired strobe mode is either highlighted or marked with a cursor.

Referring now to Fig. 4, when the DSC 10 is powered ON the control circuit 30 checks the memory 38 in order to determine which strobe mode to go into. Once the DSC 10 has been powered ON, the user can select the strobe mode in two different ways. First, the user can depress the strobe pushbutton 70a on the top of the camera housing 14. Second, the user can select the strobe mode via the GUI using one or more of the pushbutton controls and following the menus shown on the LCD display 56. Using the strobe pushbutton 70a allows the strobe mode to be changed for the current picture taking session only. Once the DSC 10 is powered OFF, the current selected strobe mode is "forgotten". Using the GUI, the user can set a default strobe mode, i.e. from that point forward, the DSC will operate in that strobe mode, and will go into that strobe mode when the DSC is later powered ON until the user changes the strobe mode setting via the GUI.

Fig. 5 is a flow diagram illustrating the operation of the customizable strobe default of the digital still camera of Figs. 3 and 4. The camera 10 first goes through a powerup sequence as a result of the user depressing the pushbutton 62 to turn ON the camera 10. The control circuit 30 sets the strobe mode to the default mode stored in the non-volatile RAM portion of the internal memory 38, if one has previously been set by the user via the GUI. If not, the camera 10 assumes the default mode, which is preferably the AUTOMATIC strobe mode, although the default mode can be selected by the user via the GUI. If the user initiates a strobe change operation via the pushbutton 70a or via the GUI the control circuit 30 handles the two strobe change operations differently. A strobe change initiated by the pushbutton 70a is stored in the volatile RAM portion of the internal memory 38 and sets the strobe mode for the current picture taking session only, i.e. until the strobe mode is changed or the camera 10 is powered OFF. Any strobe mode change initiated by the pushbutton 70a is forgotten when the camera

10 is powered OFF. If a strobe mode change is selected by the GUI, it is stored in the non-volatile RAM portion of the internal memory 38 and sets the strobe mode not only for the current picture taking session but also as the default mode when the camera is powered ON the next time, unless the strobe mode is changed via the GUI in the intervening time period.

Thus the present invention allows the DSC user to customize the strobe mode settings to his or her particular needs. The DSC 10 can be programmed so that novice can use the top-of-the-camera strobe pushbutton 70a to select, for example, to turn the strobe OFF mode, and unless he or she changes the strobe mode via the GUI, the DSC 10 will always power ON in the AUTOMATIC strobe mode. The DSC 10 can be programmed so that the more advanced user can use the GUI to set the default strobe mode so that when the camera is powered ON it will go into the strobe mode most often used, or preferred by, the more advanced camera user. This more advanced user can then use the strobe pushbutton 70a on the top of the camera housing 14 to set the strobe mode for individual pictures or sessions.

Thus the present invention provides not only a DSC with a customizable strobe default but, in addition, a novel method of controlling the strobe operation of a digital still camera. The method involves the steps of, during a powerup sequence of the camera, setting a strobe operating mode of the camera to a previously programmed strobe default mode and discharging the strobe in accordance with the default mode during a current picture taking session. The method further involves the step of permitting the strobe operating mode of the camera to be changed to a current strobe mode during the current picture taking session and thereafter discharging the strobe in accordance with the current strobe mode only during the current picture taking session. In addition, the method involves the step of permitting the strobe

operating mode of the camera to be changed to a default strobe mode and thereafter discharging the strobe in accordance with the default strobe mode during the current picture taking session and after the powerup sequence of the camera until the strobe operating mode is either changed to a different current strobe mode or a different default strobe mode.

It will be appreciated that a novice user is more likely to simply select the current strobe mode by depressing pushbutton 70a and is less likely to go through the menus on the display 56 to adjust the current strobe operating mode via the GUI. Accordingly, the novice user is unlikely to upset a factory programmed setting of the default strobe mode to the AUTOMATIC strobe mode. Thus the novice user is protected from turning ON the camera and taking a picture in low light conditions when the strobe operating mode is set to the strobe OFF mode. However, the advance user has the option of going into the GUI and setting the strobe default mode to a desired mode, which will the strobe operating until it is changed via the GUI, regardless of turning the camera OFF and ON repeatedly, until the strobe operating mode is changed via the pushbutton 70a or the GUI. In the case of the former, the selected mode will only be a current strobe mode, i.e. one that will be forgotten when the camera is turned OFF. In the case of the later, the selected mode will be the default mode in addition to the operating mode in the current picture taking session.

The present invention is also useful in DSCs equipped with the RED EYE AUTO and RED EYE ON strobe modes. These modes can be selected via the pushbutton 70a or the GUI. Selecting one of these modes via the pushbutton 70a will cause that mode to only last for the current picture taking session, i.e. until the strobe mode is changed or the camera is powered OFF. These modes can also be selected via the GUI in which case they will not only last for the

current picture taking session, but will become the default strobe mode, until the strobe mode is once again changed via the GUI, regardless of the fact that the camera has been powered OFF after the GUI selection. Of course, any default strobe mode that the camera 10 goes into can be overridden by a strobe mode selection made via the pushbutton 70a, but only for the current picture taking session. Once the camera 10 is powered OFF, and then powered ON again, it will resume the default strobe mode most recently selected via the GUI.

While preferred embodiments of the digital still camera and strobe default method have been described and illustrated herein, it should be understood by those skilled in the art that the invention may be varied in both arrangement and detail. The invention can be embodied in other camera designs and strobe default methods besides these preferred embodiments. Therefore, the protection afforded the invention should only be limited in accordance with the following claims.

CLAIMS

1. A digital still camera (10) with a customizable strobe default, comprising:

a housing (14);

a lens (16) mounted in the housing (14) for transmitting therethrough light from objects and scenes of interest;

an image sensor (18) mounted in the housing (14) for receiving the light transmitted through the lens (16) and generating output signals representative of an image of an object or a scene of interest;

a processing circuit (22, 24, 26, 28, 36) mounted in the housing (14) and connected to the image sensor (18) for processing the output signals from the image sensor (18) as a plurality of pictures are taken in succession to generate a plurality of sets of pixels representative of a plurality of images of objects and scenes of interest;

a strobe (74) mounted in the housing (14);

a strobe charge/discharge circuit (72) mounted in the housing (14) and connected to the strobe (74);

a plurality of manually actuable controls (62, 64, 66a, 66b, 68, 70a, 70b) mounted in the housing (14) so that they can be manipulated by the fingers of a user;

a memory (38, 44) mounted in the housing (14); and

a control circuit (30) mounted in the housing (14) and connected to the processing circuit (22, 24, 26, 28, 36) for generating a plurality of image files from the sets of pixels and storing the image files in the memory (38, 44), the control circuit (30) being connected to the strobe

charge/discharge circuit (72) for firing the strobe (74) under predetermined conditions when a picture is taken in accordance with one of a plurality of strobe modes, the control circuit (30) being connected to the controls (62, 64, 66a, 66b, 68, 70a, 70b) for permitting the user to select a current strobe mode and a default strobe mode from the plurality of strobe modes, and the control circuit (30) causing the strobe (74) to be fired in accordance with the current strobe mode during a current picture taking session and the default strobe mode after the current picture taking session is terminated and the camera (10) is subsequently powered ON.

2. The digital still camera (10) of Claim 1 wherein the plurality of strobe modes are selected from the group consisting of a strobe ON mode, a strobe OFF mode, an AUTOMATIC strobe mode, a RED EYE AUTO strobe mode and a RED EYE ON strobe mode.

3. The digital still camera (10) of Claim 1 and further comprising a display (56) mounted in the housing (14) for displaying alphanumeric and/or graphic information so that it can be viewed by a user.

4. The digital still camera (10) of Claim 3 wherein the control circuit (30) is connected to the controls (66a, 66b, 68) and the display (56) and provides a graphical user interface that enables a user to select one of a plurality of strobe modes.

5. The digital still camera (10) of Claim 4 wherein the control circuit (30) is also connected to the controls (70a, 70b) to enable the user to select one of the plurality of

strobe modes via manual actuation of the controls (70a, 70b) without utilizing the graphical user interface

6. The digital still camera (10) of Claim 5 wherein the control circuit (30) further permits the controls (66a, 66b, 68) to be actuated so that the user can manually select a current strobe mode and select a default strobe mode utilizing the graphical user interface.

7. The digital still camera (10) of Claim 6 wherein the control circuit (30) does not save the current strobe mode that has been manually selected when the camera (10) is powered OFF.

8. The digital still camera (10) of Claim 1 wherein the memory (38) includes a non-volatile RAM portion and a volatile RAM portion.

9. The digital still camera (10) of Claim 8 wherein the current strobe mode is stored in the volatile RAM portion of the memory (38) and the default strobe mode is stored in the non-volatile RAM portion of the memory (38).

10. The digital still camera (10) of Claim 1 wherein the current strobe mode and the default strobe mode are selected using a display (56) mounted in the housing (14).

11. A digital still camera substantially as herein described with reference to the accompanying drawings.

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Application No: GB 0017719.6 **Examiner:** Richard Nicholls
Claims searched: 1-11 **Date of search:** 25 January 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): G2A (ABED, ABM, ABSA, ABSX, ACDA, ADPC, ADPX)

Int Cl (Ed.7): G03B 15/05

Other: Online databases: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	US 4959679 A	(Minolta) see especially column 1 line 57-column 2 line 2	
A	US 4395100 A	(Olympus) see especially claim 1	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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